

INTRODUCTION

In the Arctic, liquid-cloud layers form even below 0°C and persist for several days to a few weeks. These clouds are frequently mixed-phase, with liquid and ice in the same volume. The presence of liquid impacts ice growth processes.

This study presents a mesoscale structure and dominant ice growth processes in a boundary-layer mixed-phase cloud on 3 May 2013, using X-band polarimetric radar measurements.

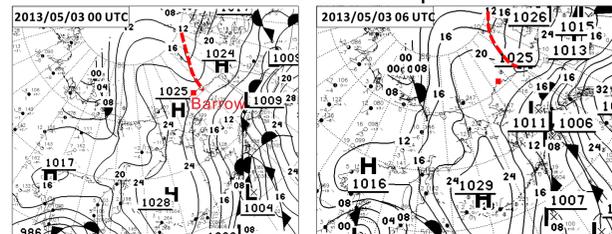
SUMMARY

Mesoscale structure and dominant ice growth processes in an Arctic boundary-layer mixed-phase cloud observed by the X-band polarimetric radar:

- Multiple liquid-cloud layers in different airmasses (northwesterly-, northerly-, and northeasterly-wind layers)
- Depositional growth of dendrites in (multi-layered) thin (<100 m) liquid-cloud layer
- Riming process in a thick (200 – 400 m) liquid-cloud layer
- Aggregation process in and below a thick liquid-cloud layer

ANALYSIS

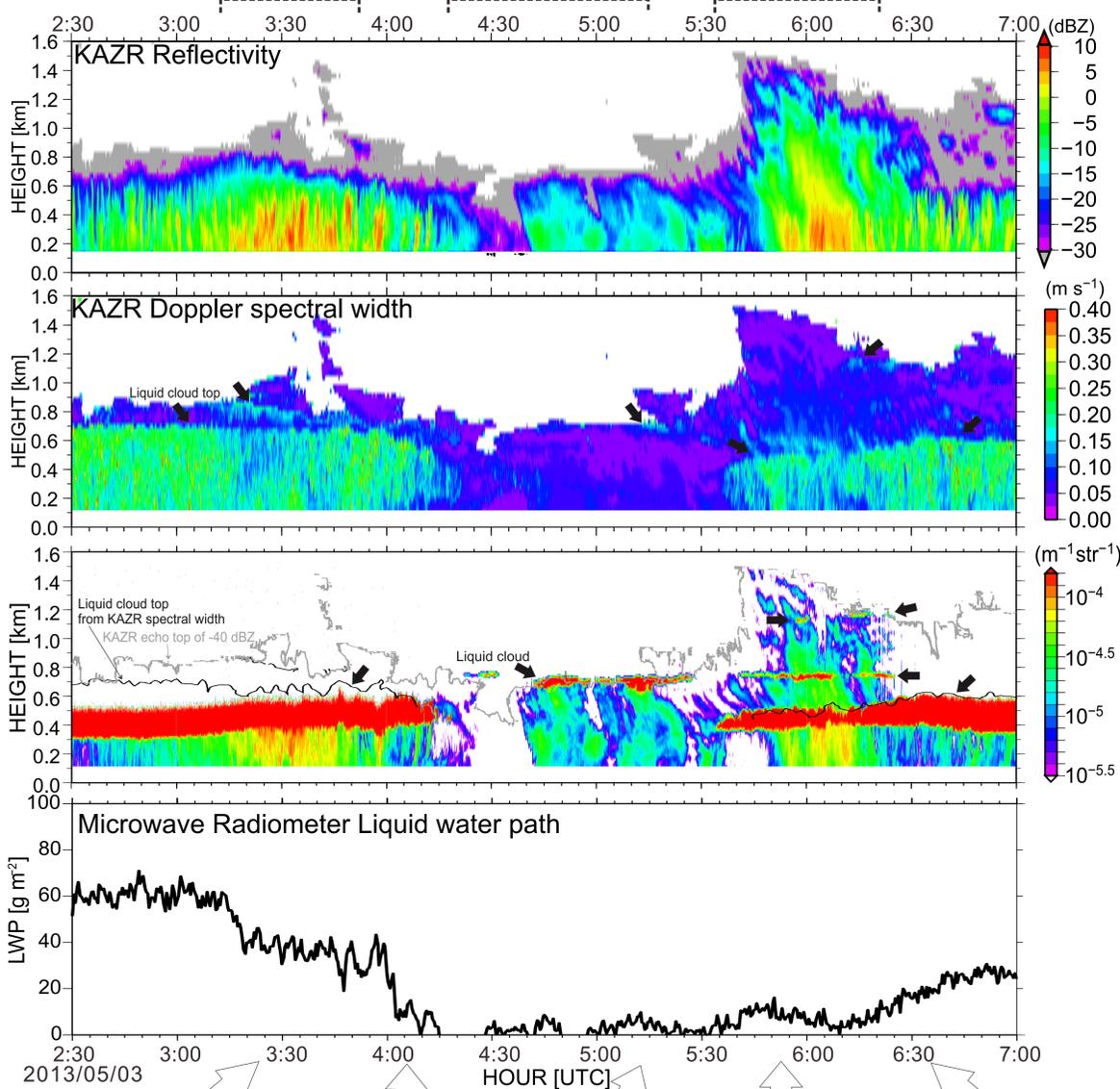
Surface weather map



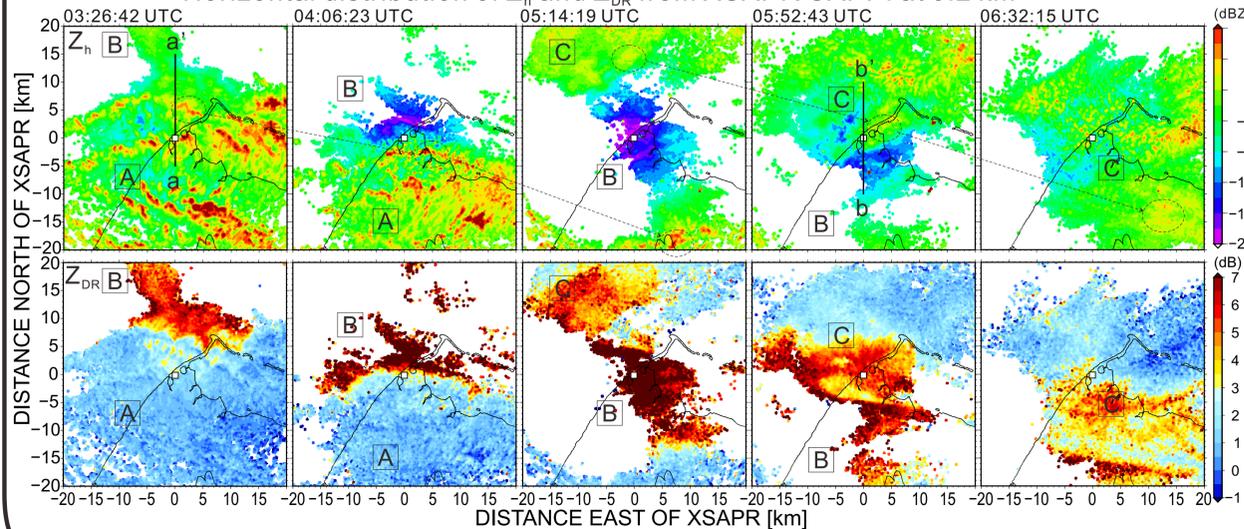
A

B

C

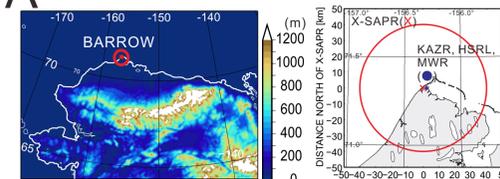


Horizontal distribution of Z_h and Z_{DR} from XSAPR CAPPI at 0.2 km



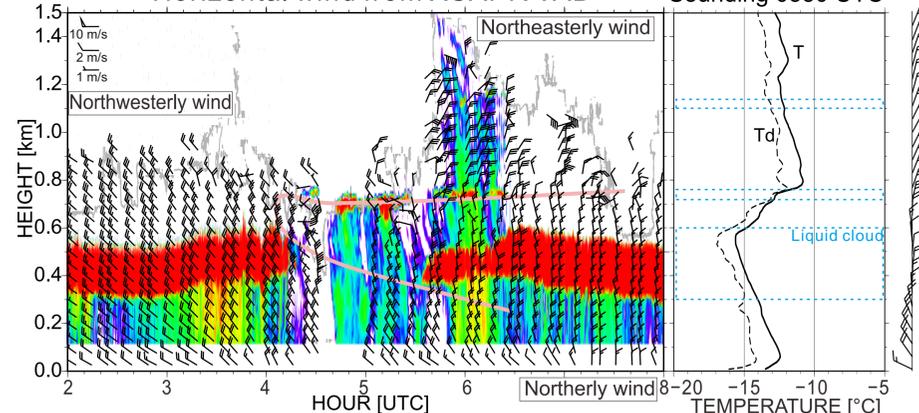
DATA

- X-band Scanning ARM Precipitation Radar PPI volume scan (X-SAPR, ×)
- Ka ARM Zenith Radar (KAZR, •)
- High Spectral Resolution Lidar (HSRL, •)
- Microwave Radiometer (MWR, •)



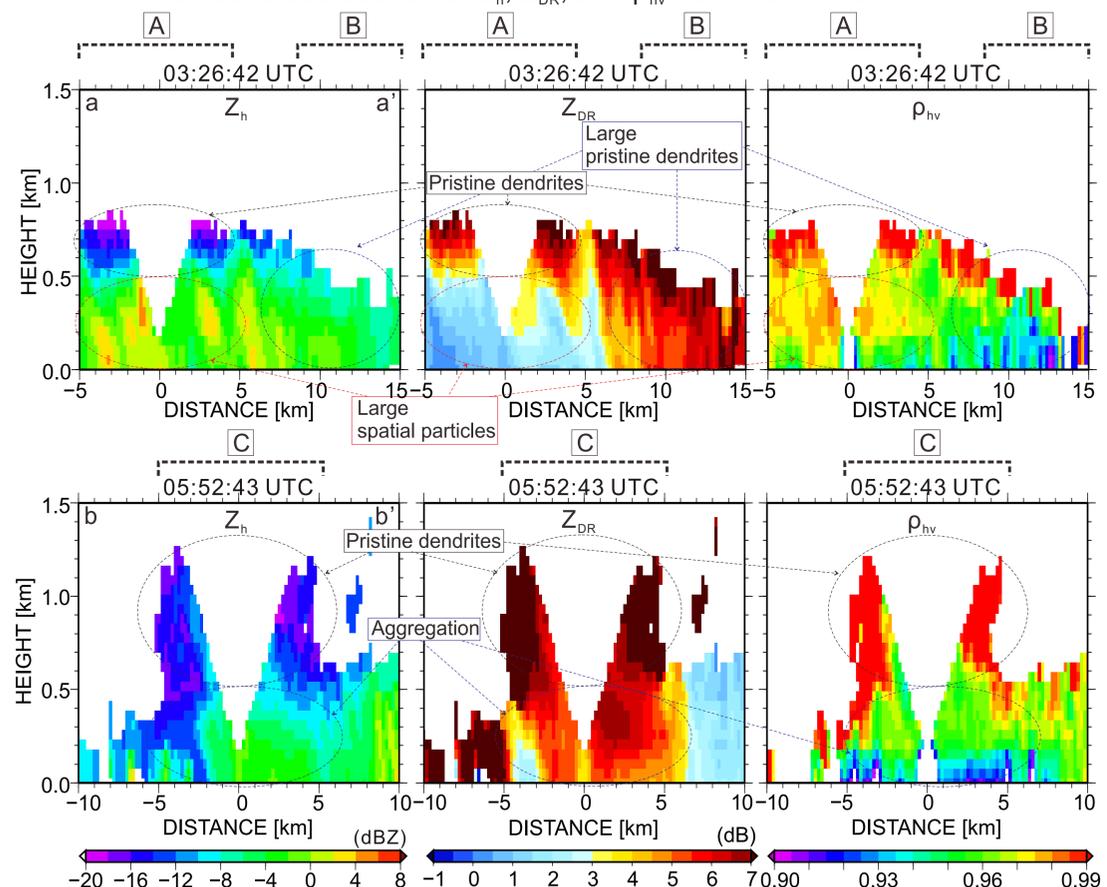
Horizontal wind from XSAPR VAD

Sounding 0530 UTC



- Liquid-cloud layers would form in different airmasses by advection.
- Former thick liquid-cloud layer: Northwesterly-wind airmass
- Upper thin liquid-cloud layer: Northeasterly-wind airmass
- Latter thick liquid-cloud layer: Northerly-wind airmass
- Middle thin liquid-cloud layer: Top of Northerly-wind airmass

Vertical cross section of Z_h , Z_{DR} , and ρ_{hv} from XSAPR CAPPI



- A: High Z_{DR} and high ρ_{hv} – Pristine plat-like crystals (dendrites, all are similar shapes)
High Z_h and low Z_{DR} – Large, spatial particles
Upper cloud ice particles growing as dendrites seeded thick liquid layer below and quickly grew as spatial particles by riming and aggregation.
- B: High Z_{DR} and low ρ_{hv} – Large pristine dendrites
Ice particles formed near the thin liquid cloud layer and individually grew as dendrites by depositional growth.
- C: High Z_{DR} – Pristine dendrites
Decreasing Z_{DR} with decreasing height – Aggregation
Ice particles individually grew as pristine dendrites while falling through multiple thin liquid layers by depositional growth.
Dendrites were rimed in the low-level thicker liquid layer and aggregated in and below the low-level thicker liquid layer.